

# **Advanced Accelerator Applications Technical Quarterly Review**

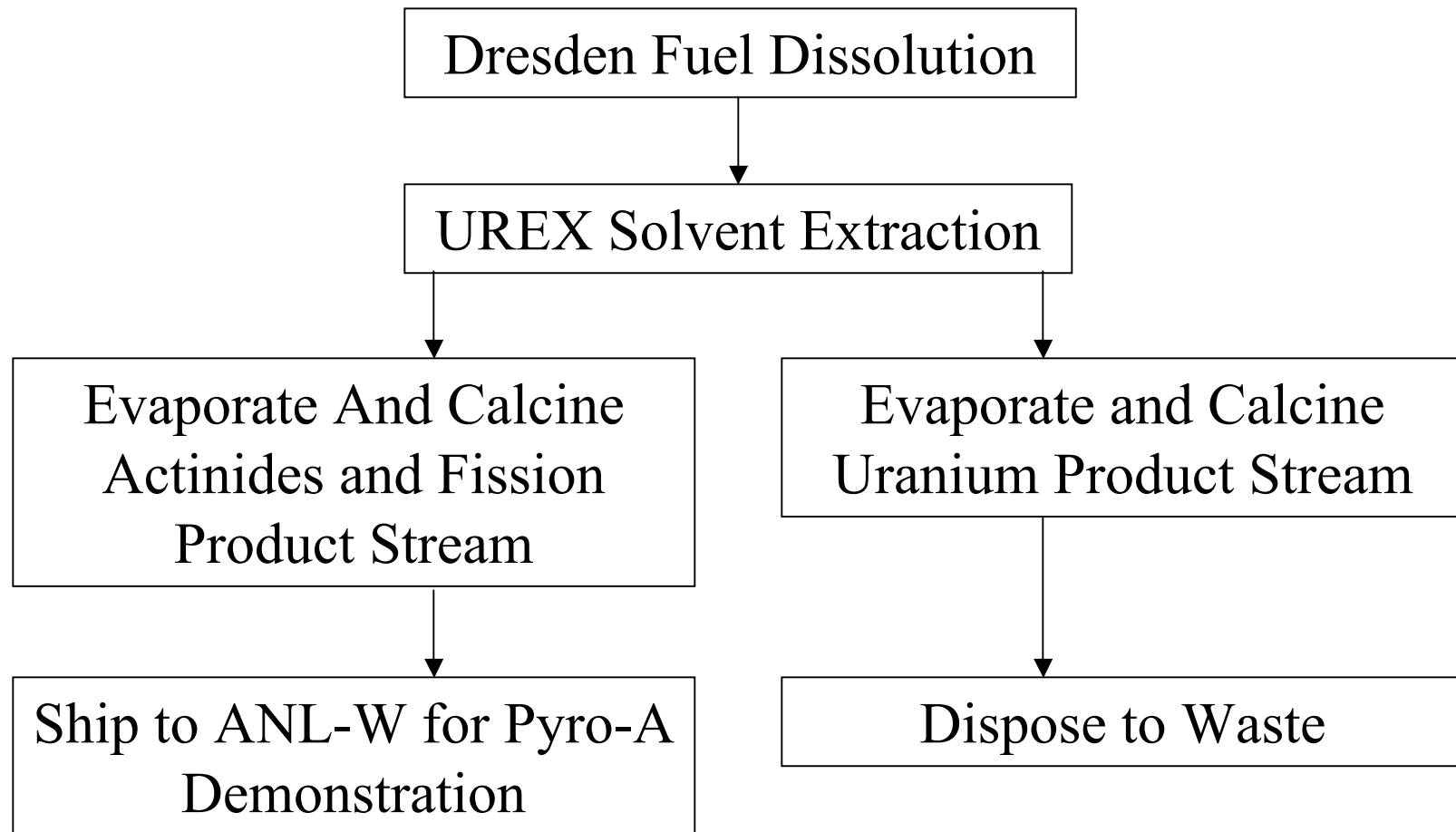
**(Covering January-June 2002)**

## **UREX Hot Demonstration**

**WBS 1.24.02.01**

**Major Thompson, Project Leader  
July 9, 2002**

# Scope of UREX HOT Demonstration



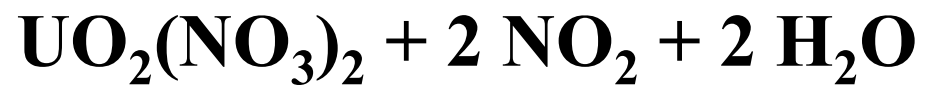
# Dresden Fuel History

- **BWR fuel irradiated to 28,000 MWD/MT**
- **Discharged 9/1/75**
- **MC&A records 3.98 kg U, 28.54 g Pu**
- **Cut into 3-4 inch length and placed in cans**
- **Stored at SRTC since 1979**
- **Similar material at ORNL contained on 7/31/2000**
  - **2.5 g Am and Cm**
  - **163 Ci  $\text{Sr}^{90}$  and 169 Ci  $\text{Cs}^{137}$**

# Dresden Fuel Dissolution

- **Dissolver ~6 L total volume**
- **Dissolved in HNO<sub>3</sub> at 90°C**
  - **Started with 4 M HNO<sub>3</sub>; added increments of 10 M HNO<sub>3</sub>**
  - **3 batches required**
  - **~14 hours heating time per batch**
  - **Hulls leached with fresh acid for next batch**
  - **Interior and exterior of hulls clean**
  - **Fine black undissolved solids collected**
  - **Total weight of material into dissolver 4.6 kg**

## Dresden Fuel Being Dissolved



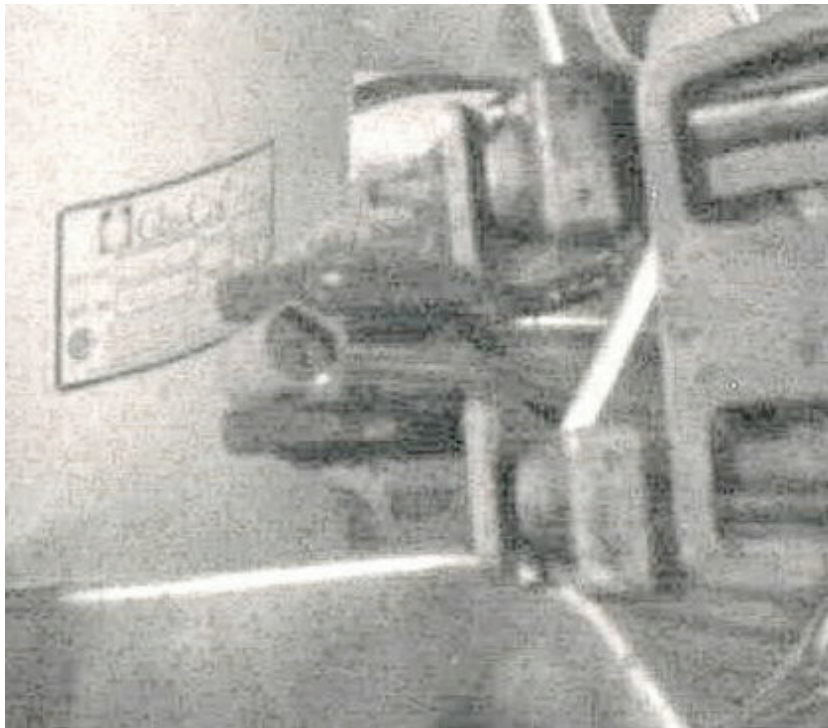


# Dresden Fuel Condition



# Dresden Hulls

Before Dissolution



After Dissolution

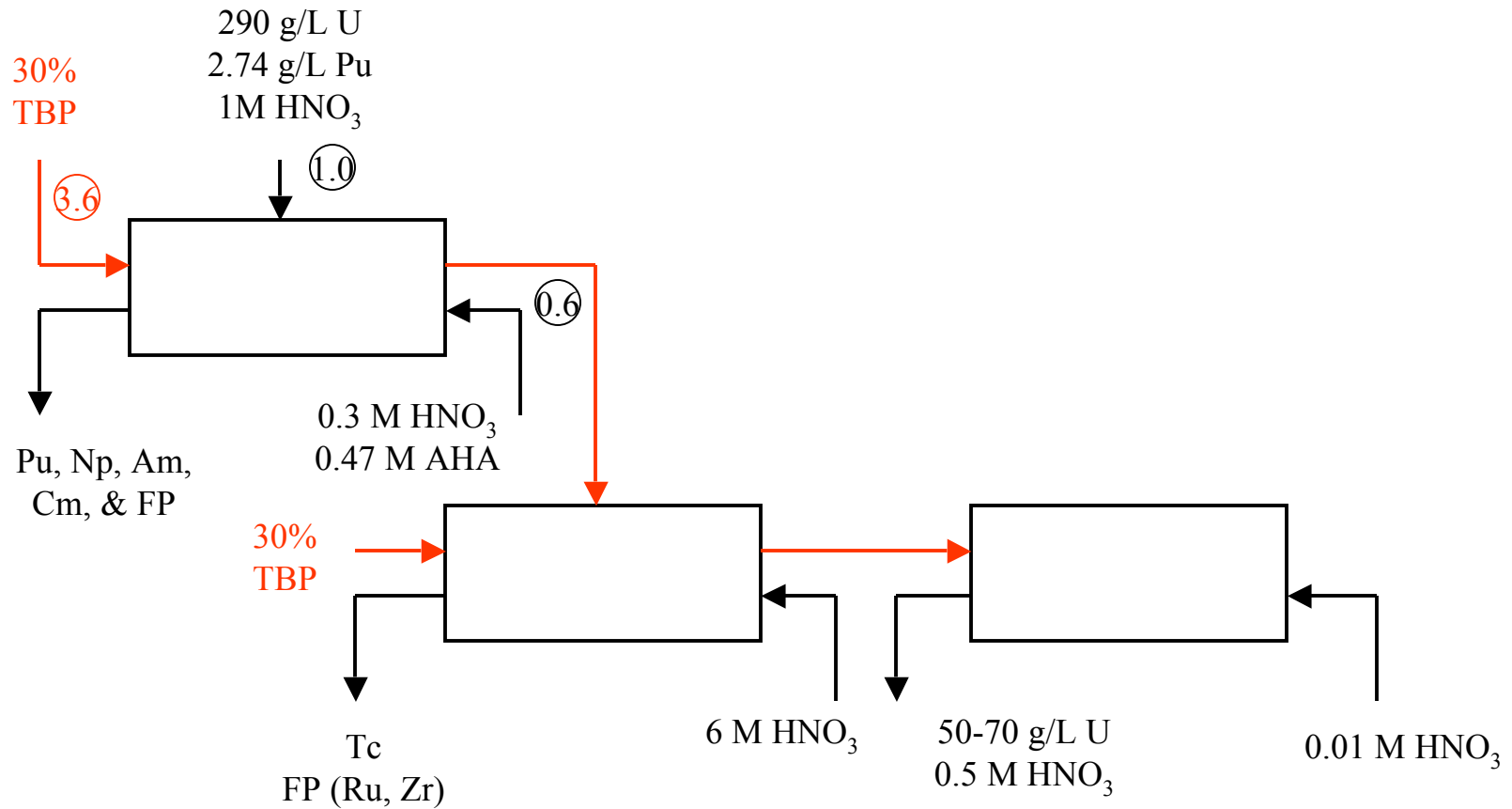


# Dissolution Status

- **Dissolution complete**
  - 3.89 kg material dissolved, calculate 3.4 kg U
  - 7.3 L solution
    - » 1.45 M acid
    - » Density 1.724 g/mL
    - » Estimated U conc'n 469 g/L
  - Solution sampled for analysis
- **Sample of cladding taken for analysis**
- **Undissolved solids sampled for analysis**



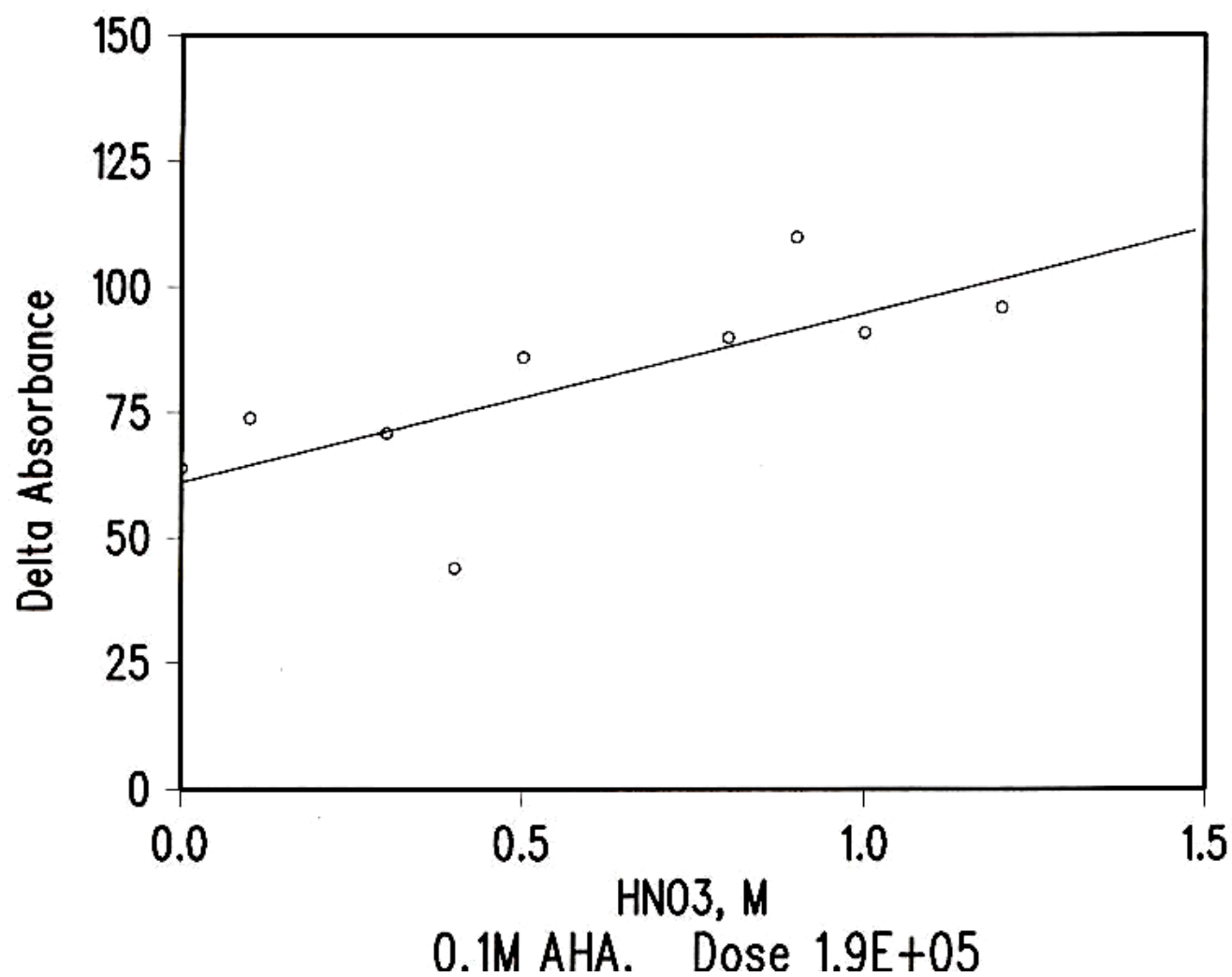
# UREX Solvent Extraction Flowsheet



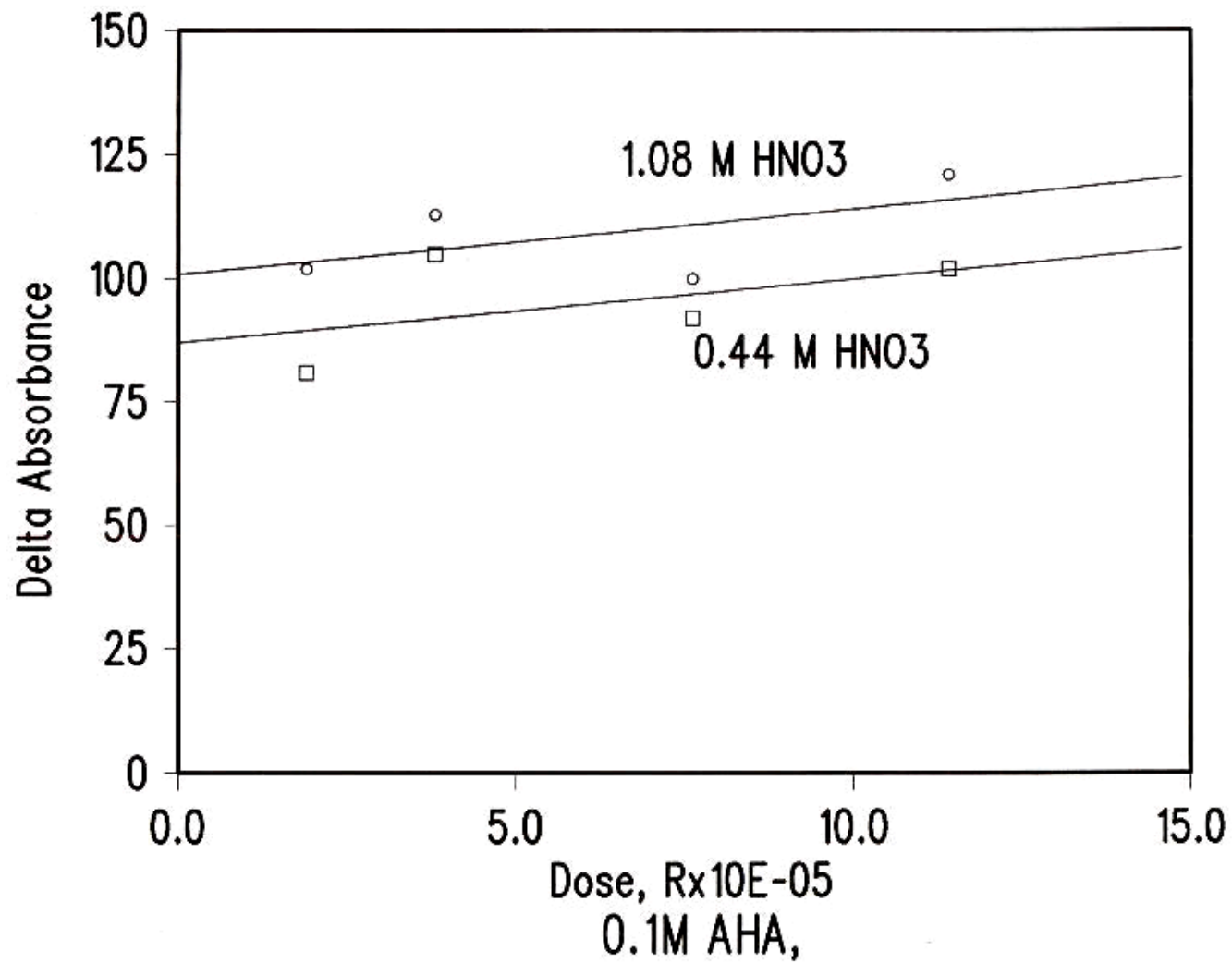
# AHA Radiolytic Stability

- **Acetohydroxamic Acid (AHA)**
  - Undergoes acid hydrolysis
$$\text{CH}_3(\text{C}=\text{O})\text{NHOH} + \text{H}^+ \rightarrow \text{CH}_3\text{COOH} + \text{NH}_3\text{OH}^+$$
  - Analysis by absorbance of Fe(III) complex at 505-530 nm
  - Requires controls for each test
  - Radiolytic destruction measured by difference between control and sample irradiated

## Acid Dependence of Stability



## Dose Dependence for AHA



# Summary of Radiation Studies

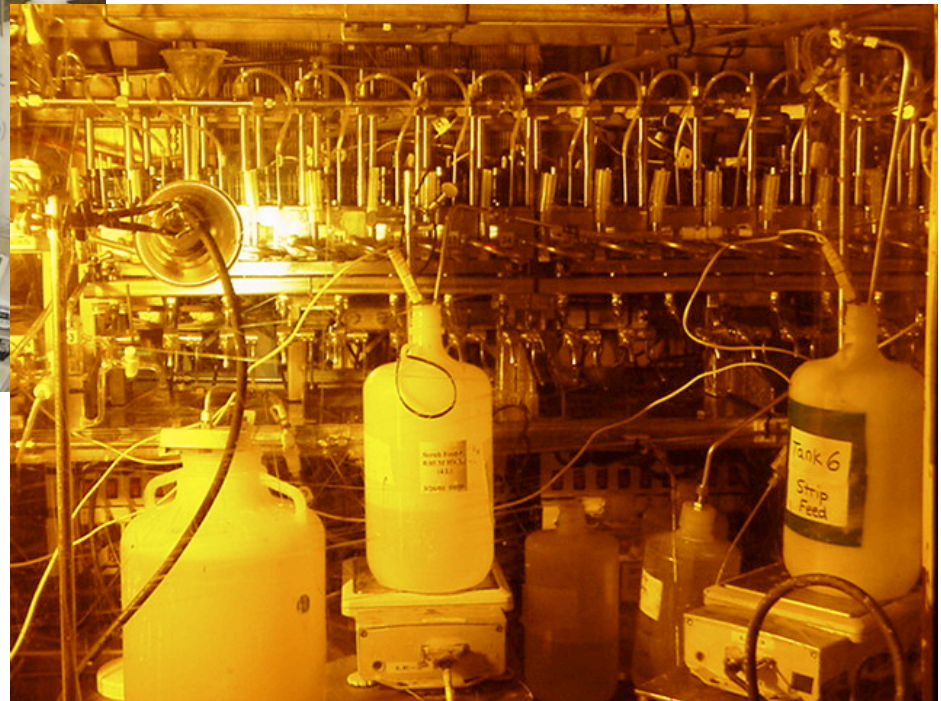
- **AHA is fairly stable to radiation in range of doses expected in UREX process**
- **Stability attributed to scavenging of radicals by products of acid hydrolysis such as acetic acid and hydroxyamine**

# UREX Hot Demonstration

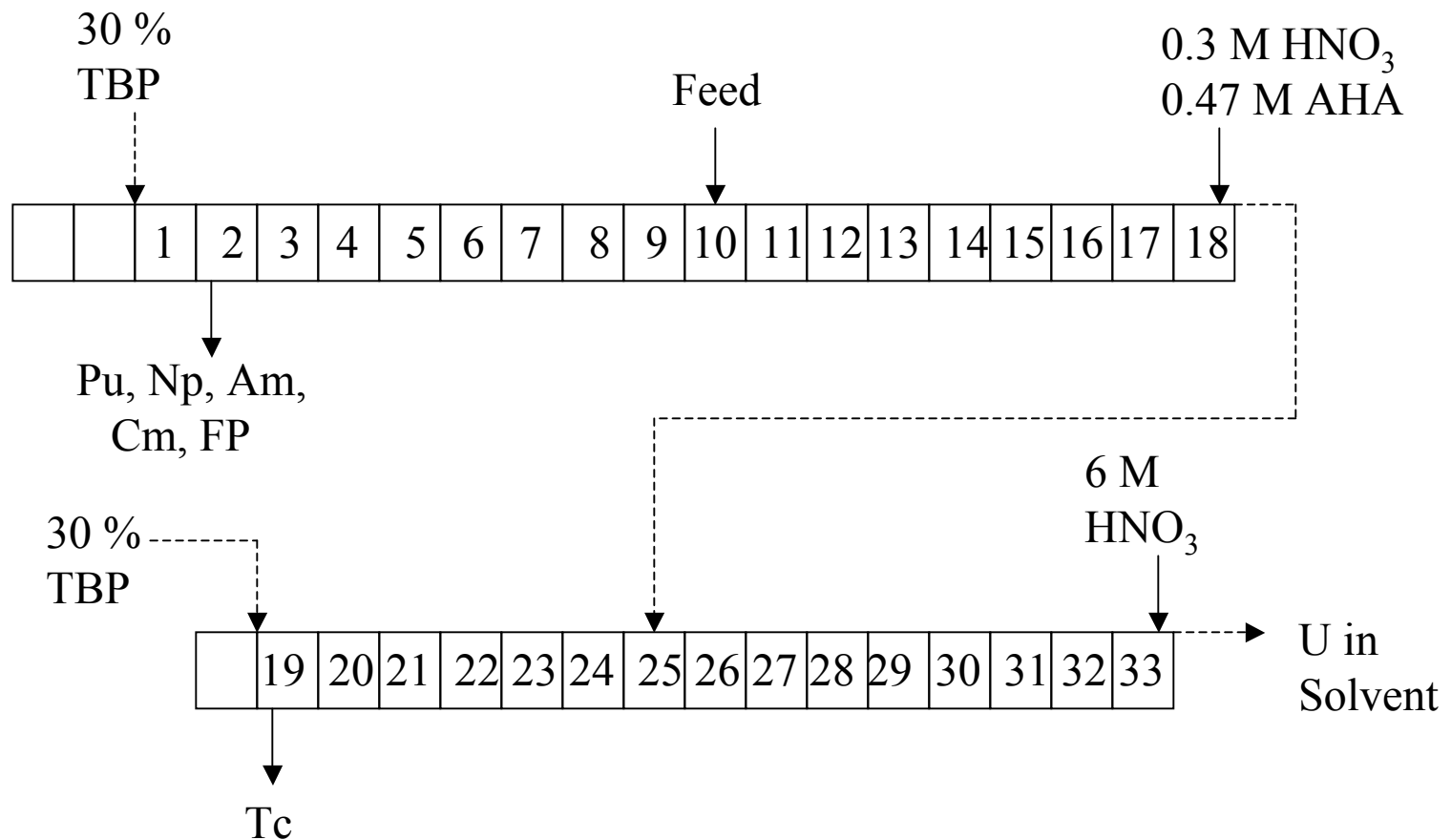
- **Centrifugal Contactors in Shielded Cells**
  - Extraction, scrub and Tc separation in cells
  - Some reconfiguration of equipment required
- **Actinide/Fission Product Stream**
  - Evaporation with rotary evaporator
  - Calcination in lab muffle furnace
- **U Product Stream**
  - Strip from solvent in laboratory hood
  - Evaporate and calcine aqueous U in hood
- **Tc Product Stream**
  - Conversion to metal in FY03



# Centrifugal Contactors for UREX Hot Demo



# UREX Equipment Diagram



# Status of Solvent Extraction

- **Acetohydroxamic acid (AHA) and pumps at SRTC**
- **Solvent obtained from plant**
- **All NEPA and safety documentation complete**
- **Paperwork for French observer in approval process**

# Accomplishments

- **Completed following milestones**
  - SD24M0051 Complete Dissolution of Dresden Fuel
  - SD24M0054 Complete radiation tests AHA
  - SD24M0055 Issue report on AHA radiation stability tests
  - SD24M0056 Issue report on literature search on alternative
- **UREX Solvent Extraction**
  - **Pulled back schedule 2 weeks to complete in August**
  - **Salt program tests complete this week allowing work to start July 15**

## FY02 Plans

- **Start flush of contactors on July 15**
- **Complete initial UREX hot demonstration by Aug. 23**
- **Complete processing all Dresden fuel solution by Aug. 30**
- **Complete draft report on UREX hot demonstration by Sept. 27**
- **Complete procurement & set up of equipment for UREX raffinate evaporation by Sept. 20**